

Biomedical Applications of Fluorinated Fluids

Navarrini W.^{1,*}, Cantini M.¹, Casati A.¹, Ranzoni A.¹, Sciacca B.², Guala C.², Masella M.¹,
Sallemi L.¹, Scotti F.¹, Canesi E.¹, Resnati G.¹, Metrangolo, P.¹, Costantino M.¹

¹ Politecnico di Milano, Piazza Leonardo da Vinci 32, 20133, Milan, Italy.

² Politecnico di Torino, Corso Duca degli Abruzzi 24, 10129 Turin, Italy

INTRODUCTION

What is ASP?

The Alta Scuola Politecnica (ASP), founded by Politecnico di Milano and Politecnico di Torino, is a school for young talents who want to develop their interdisciplinary capabilities for leading and promoting innovation.

ASP students complement the knowledge achieved in their specific graduate course with a multifaceted and enriched understanding of innovation processes and contexts through additional courses and a multidisciplinary project.

Multidisciplinary Projects (1/2)

Multidisciplinary Projects focus on problems and opportunities raised by external institutions (i.e. firms, governmental or research institutions). The problems proposed are complex and systemic in nature and require the integration of competences from different disciplines. Projects are in fact carried out by teams of students coming from the different Schools of both universities and each project team is assisted by tutors with a multifaceted background.

Multidisciplinary Projects (2/2)

Multidisciplinary Projects are an opportunity to practice the process of envisioning, framing, planning and implementing innovation, and to experiment the capabilities developed both in the laurea magistrale and in the ASP courses.

The Project "Intelligent Diagnostic Tools and Smart Drug Delivery: Biomedical Applications of Fluorinated Fluids", proposed by Solvay-Solexis S.p.A. and Bracco S.p.A., focuses on the preparation, characterization and use of fluorocarbon-based diagnostics and drug delivery agents. The unique properties of fluorocarbon have in fact triggered numerous biomedical applications of these compounds and this project is intended to further explore the opportunities of this research field.

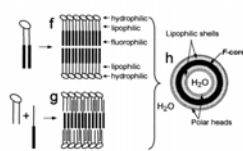
Disciplines involved in the project

» Materials » Bioengineering » Physics » Computer science

PROJECT EARLY RESULTS

ADVANTAGES OF PERFLUORINATED MATERIALS

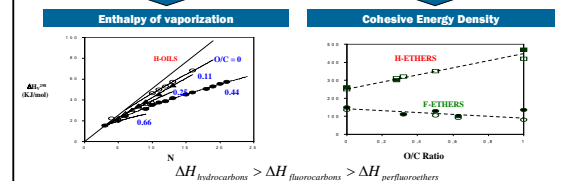
- HYDROPHOBICITY
- LIPOPHOBICITY
- INERTNESS
- LOW OSTWALD COEFFICIENT
- HIGH VAPOUR PRESSURE
- HIGHER MOLECULAR WEIGHT (compared to hydrocarbons)



PERFLUOROETHERS IN BIOMEDICINE

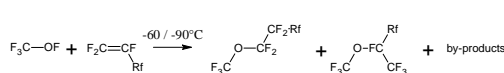
SMART DRUG DELIVERY
INTELLIGENT DIAGNOSTIC TOOLS

ADVANTAGES OF PFE



PFE SYNTHESIS

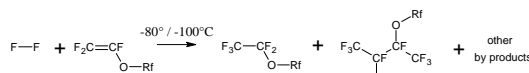
Hypofluorite Addition



Rf = F, CF₃, OCF₃, OCF₂CF₃, O(CF₂)₂CF₃

W. Navarrini, V. Tortelli, A. Russo, S. Corti, J. Fluorine Chem., 95, 1999, 27.

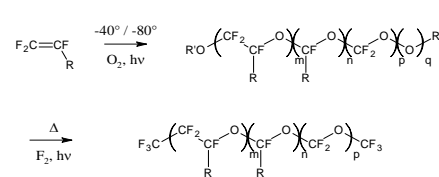
Direct Fluorination



Rf = CF₃, CF₂CF₃, (CF₂)₂CF₃

R. D. Chambers, Chapter 2, IV Fluorination with Elemental Fluorine, in "Fluorine in Organic Chemistry", Blackwell pub., 2004, 35.

Photo-oxy-polymerization



R=F, CF₃

R'=CF₃, COF, CF₂COF

D. Sianesi, G. Marchionni, R. DePasquale, in "Organofluorine Chemistry Principles and Commercial Applications", R. E. Banks et al., Plenum Press, 1994, Chapter 20, 431.

Synthesis Processes Comparison

| | Hypofluorite-addition | Direct fluorination | Photo-oxy-polymerization |
|---|----------------------------|--------------------------------------|--|
| Molecular weight | Low | Low | High |
| Outcome | Structural isomers | Single product | Complex mixture |
| Experimental complexity and safety requirements | High | Medium | High |
| Product purification complexity | Medium | Medium | High |
| Starting materials | Not commercially available | Commercially available High price | Commercially available Medium price |

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*Corresponding Author

Walter Navarrini

Politecnico di Milano, Via Mancinelli 7, 20131 Milan, Italy

E-mail: navarrini@chem.polimi.it

Conclusions:

Hypofluorite addition and direct fluorination allow the synthesis of fluorinated fluids, which can be used as contrast agents for diagnostics or for gas-embolotherapy. Photo-oxy-polymerization is a process for the production of perfluorinated liquids, that can be employed as emulsions in blood substitutes and drug delivery systems.